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DR. WERNER VON SIEMENS.

Personal Recollections of Werner von Siemens. Translated by W. C. Coupland. (Asher and Co., 1893.)

WERNER VON SIEMENS was a representative man of this nineteenth century, the century in which "the art of directing the great sources of power in nature for the use and convenience of man" has been more studied and applied than in any other, we were almost saying than in all others. And no other century has produced quite such a man—a man in whom the ability to apprehend the secrets of nature was united with the ability to apply them to industrial purposes. Many circumstances combined to favour him, both of a personal and public character. His father was evidently a man of strong common sense; his mother was refined in her tastes, cultured in her mind, and devoted to her children. The children were fortunate in having such parents to guide and watch over them. At that time, as now, first-rate schools and colleges existed throughout what now forms the German Empire, and in these a good mathematical and scientific education was to be obtained, which was taken advantage of by the Siemenses, both as boys and young men. Another matter which was specially favourable to Werner Siemens was his military training; regular drill, strict discipline, endurance, and implicit obedience, learnt and practised in his own person, helped to make a man of him. Besides this, these young men were born just at the right time, if we may say so, to take advantage of the recent discoveries in, and formulation of the principles of, the natural sciences of heat and electricity and magnetism. These sciences were at that period in the active, nascent state. Galvani and Volta, Gauss and Weber, Oersted and Faraday had set the world wondering, and themselves, the philosophers, thinking, analysing, and systematising, and the men of imaginative minds, the poets of industry, inventing. Great discoveries had been made in former days, but these were in the realms of the Cosmos; they were not suitable for application to the daily uses of men, and were not, as those were, startling and impressive.

One of the first applications of electricity was to electro-plating, the covering of the baser metals with a thin layer—almost a film—of the nobler metals. And when in 1842 Werner Siemens applied for and obtained a Prussian patent, no process of galvanic gilding or silvering was known in Germany. He tells us that he had experimented with all the gold and silver salts known to him, and besides the hyposulphites had also found the cyanides suitable. The use of the latter had been made and patented by the Messrs. Elkington of Birmingham, so that a patent was only granted to Werner Siemens for the former. His brother William was despatched to England, where he took out a patent which he succeeded in selling to the Messrs. Elkington for £1500, and this money helped the young men on their road to independence and fame.

Whether it is that the minds of those engaged on the problems connected with the application of the forces of nature to industrial purposes are necessarily turned towards the measurement and regulation of these forces, we would not say, but meters and governors seem to have a special fascination for them. And so it was with these men. The problem of the regulation of the steam-engine seems to have proposed itself to the mind of William; both brothers, however, were engaged in its solution, and the differential regulator or chronometric governor was the result.

In the work we are reviewing there are few dates, but fortunately Dr. Pole's "Life of Sir William Siemens," and the scientific and technical papers of the brothers themselves, already published by Mr. John Murray, supply these. Quoting then from a paper by C. William Siemens on the progress of the electric telegraph, we find that "in the year 1845, when the practical utility of electric telegraphs had been demonstrated in England, several continental governments had determined upon their establishment." A Royal commission was appointed in Prussia, of which Dr. Werner was the most active member. They favoured an underground system, and charged him to institute experiments.

Here we stand on the threshold leading to, and opening up on, one of the greatest achievements of modern days. The underground system was only a stepping-stone to submarine telegraphy, and was not in itself a permanent although a temporary success. But there in Germany just at this time something was wanted, and here in England it existed; and these two brothers—the elder there, the younger here—were the means of completing the circuit. In the winter of 1844-45, "I recollect well seeing the first specimen of gutta-percha exhibited at the Society of Arts, I think by Mr. Montgomerie. . . . He was kind enough to give me a piece, which I forwarded to my brother, Dr. Werner Siemens. . . . I sent him this piece of gutta-percha in order that he might try whether it was not superior to india-rubber for insulation purposes. He did so, and after some time, having procured for him at his request a further supply, he made experiments, and in the course of about twelve months he proposed to the Prussian Government the use of gutta-percha for insulating telegraphic land wire." Dr. Werner constructed a screw press, by which the heated gutta-percha was cohesively pressed round the copper wire under the application of high pressure; this was well insulated, and permanently retained its insulation. And so, just at the time that it was wanted, a substance hitherto unknown came to light!

In the summer of 1847 the first long subterranean wire from Berlin to Grossbeeren was laid, and the telegraph commission had under consideration the employment "both of the wires coated with gutta-percha by pressing, and also of my dial and printing telegraph in the telegraph system about to be introduced into Prussia." On October 12, 1847, the factory of Siemens and Halske was started, but Dr. Werner still retained his military commission. In June, 1849, he requested his discharge from the military service, and soon after also resigned his office as technical manager of the Prussian State telegraphs.

We are not attempting in any detail to survey the whole field of Dr. Werner von Siemens's activity; we are simply drawing attention to the most prominent landmarks, which may be used as points from which to carry out the triangulation, and as stations on which to set up the necessary delicate instruments of observation. Dr. Werner von Siemens was a remarkable man; he had a most successful career; he left indelible marks on the progress, both scientific and industrial, of his day, and there are lessons to be learnt from his work, and from his systems and methods.

Let us rest here a moment. This factory was just the very thing that was required at the time. The two members of the firm were—the one, Dr. Werner Siemens, a man possessing clear scientific views of natural forces and phenomena, and an inventive mind; the other, Mr. Halske, a man thoroughly acquainted with mechanics, the use of machines and tools, and possessing the skill to make, and to teach others how to make, delicate mechanism. There was a demand in Germany, in Russia, in England, and elsewhere, for what they could make; their work was thoroughly to be relied upon, and orders streamed in on them.

Dr. Siemens says somewhere in this volume that everything he has done for natural science has been due to a claim made upon him by applied science. It was the absolute necessity under which he was to make accurate measurements that set him to work to invent an exact standard of resistance, possessing which he was afterwards able to elaborate a rational method for testing the electrical condition of submarine cables. Previously to this, Jacobi's standard, which was a determined length of copper wire of a determined section, was used at the Berlin factory, but copies of these standards were found to differ so much that Dr. von Siemens set to work to introduce a standard of his own. In revolving this matter in his mind he came to the conclusion that "it was both desirable and convenient to be able to combine a definite geometrical notion with the unit of resistance." He therefore used mercury, the only metal fluid at ordinary temperatures, whose resistance cannot be affected by molecular variations, made a series of important experiments, and finally having defined his unit as a metre length of mercury of a square millimetre section at 0° C., he sent copies of his standard to physicists and telegraph engineers suggesting their use in determinations of resistance. We refrain from entering into a discussion as to the relative values of units, whether Weber's absolute unit, the B.A. c.g.s. unit, the ohm, or others; the main point is that Dr. von Siemens wanted a clearly defined unit, he had found the absolute necessity for it in his electrical work, and now possessing it he was able to press forward to other achievements. Here was a decided step in advance. Measurements which had previously been variable were now uniform, tests which formerly could not have been made could now be applied, and work which was formerly carried on more or less by rule-of-thumb, could now be done with a certainty of result.

We have referred to submarine telegraphy as one of the great achievements of this century, and the brothers Siemens, Werner, William and Carl, have taken a share in it. Almost every submarine cable of importance has been shipped from the Thames. The first tentative efforts were made in England, and the final successful results have been achieved here. Cable-laying is now one of the scientific arts, and our author has had a large share in making it so.

We are here brought face to face with the two sides of the question, the scientific and the technical, and at the same time with two national characteristics, the combination of which has produced these results: English enterprise, German investigation. And there is yet another link in this chain of events, which it is difficult to see how we could have done without, the finally unsuccessful but at the time needful and useful practical experiment of underground cables in Prussia. "My friend Halske" . . . "was the first to encounter these phenomena." "Halske found, first of all, that with shorter lines our self-interrupting indicator telegraphs acted with much greater speed than corresponded to the resistance of the line. When communication between Berlin and Cöthen had been established, a distance of about 95 English miles, the giving apparatus ran with double velocity, whilst the receiving apparatus stopped altogether. This at the time inexplicable phenomenon occurred the earlier the better the lines were insulated, which induced Halske purposely to impair the insulation of the line by the addition of artificial watery by-passes." "When the underground line had been extended to Erfurt, Halske's watery by-passes were no longer sufficient. But meanwhile I had become convinced that the peculiar behaviour of the underground wires could only be ascribed to the electrostatic charge already observed at the testings in the factory, the wire namely forming the inner, the damp soil the outer coating of a Leyden jar." "The very surprising and disturbing phenomena of electrical charges in underground conductors required thorough study. Further, it was necessary to establish a system for the determination of the situation of faults in the conduction and insulation of underground wires by measuring currents at the end of the wires. The uncertainty of the measurements of currents led to the necessity of replacing them by resistance measurements, and thereby to the setting up of fixed reproducible standards of resistance and scales of resistance. For this purpose the methods and instruments for current and resistance measurements had also to be improved and adapted for technical use; in short, a whole series of scientific problems had cropped up, the solution of which was called for by technical needs."

And so later on, when the actual problems of submarine telegraphy had to be solved, Dr. Werner took his share in their solution all the more ably because of the experience he had already gained, and of his system of studying the science on which the art was founded. His narrative, especially in this connection, is full of adventures, not unaccompanied with danger, the description of which is always interesting and often graphic.

The lesson of the life, of which a few personal recollections are given in this volume, appears to be this: Find out the work you were sent here to do, and do it with your might. All the work that has to be done is not great work, but may be good work for all that; it may not lead to honour and fortune; but it has to be done, and if you are the one who has to do it, do it well.

Dr. von Siemens had a work to do; it matters little, it seems to us, whether others were engaged on the same work or not; he did his share. As to who the person is that first made a particular discovery is often a difficult question to settle; it is, after all, perhaps a matter of accident, or shall we say rather a matter of gift. But the man who follows his guiding star, and is led by it to honour, and success, and fortune, is one whose example others may well follow, even though it may not lead those others there. A great work or a very little work has to be done; set to work and do it. There is your guiding star shining clear and bright; follow it. There may be bright scintillations to the right and left; they may be merely *ignes fatui*, or they may be other men's guiding stars; they have nothing to do with you. You may have to work hard, but any way try to work wisely!

IRON ORES.

The Iron Ores of Great Britain and Ireland. By J. D. Kendall, F.G.S. With numerous illustrations. (London: Crosby Lockwood and Son, 1893.)

ALTHOUGH numerous works relating to mineral deposits of particular districts have appeared at different times, besides larger treatises dealing with the subject generally, such as the late John Arthur Phillips' "Ore Deposits," the want of a systematic account of our present knowledge of the origin and occurrence of British iron ores, and of the means of working these ores, has long been noticed. This want will be supplied by the volume under consideration. The author is a mining engineer of thirty years' experience, and he has been able to supplement a careful study of the available literature by unpublished information derived from his own observations. The result is a volume that will prove of substantial value as a work of reference to all interested in the iron industry of this country, more especially as the published information can only be found by a laborious search through the volumes of the Journal of the Iron and Steel Institute, and of the Transactions of other societies.

Mr. Kendall has broken up his volume, which covers 430 pages, into four parts. In the first, he gives some interesting information regarding the early working of iron ores, of which there is indirect evidence in nearly all the valleys of the Lake district. The presence of Roman coins, some of them as early as Trajan, found in heaps of iron cinder in Sussex and near Monmouth, proves that iron was made at a very early period from the red and brown oxides. Indeed, it is possible that these beds were worked at an even earlier period, for flint flakes and rough unturned pottery were found by Boyd Dawkins on the surface of a slag heap near Battle. In the second part, the author discusses the geological position and mineralogical characteristics of iron ore deposits. The third section deals with the age and origin of the deposits, and the last describes the method of searching for and working iron ores, with useful information on working costs, selling prices, and conditions of leases.

The author's task is not a light one. Within the limits of 430 pages to describe even the main features of the long list of mines which give the United Kingdom (1891) its 12,777,689 tons of iron ore, valued at £3,355,860 at the pit's mouth, is by no means easy. With the aid of forty-one illustrations and five folding plates, he has, however, been enabled to compress a large amount of information within a comparatively small compass, the value of the descriptions being increased by the insertion of bibliographies for each district.

As would naturally be expected, all the ores noticed in the volume are not treated with equal fulness, preference having been given to those of the greatest commercial or scientific importance. It is to be regretted that the great lode of Perran, near Truro, should have been dismissed in a single line. The late Sir Warington Smyth made many attempts to introduce this curious deposit to the notice of ironmasters, and it has formed the subject of numerous important memoirs. The most interesting descriptions given by Mr. Kendall are perhaps those relating to the district with which he is specially acquainted—the hæmatite district of West Cumberland and Furness, a district which has received less attention from geologists than any other of equal importance in the British Isles. The ores are of special value for the part which they play in admixture with the poorer qualities of ironstone, as well as for the production of Bessemer pig-iron. So irregular, however, are these deposits that the boring-tool may easily pass within a few inches of a mass worth thousands of pounds without discovering a trace of it. There can be no doubt that the acquirement of an accurate practical knowledge of these irregular deposits, of which the surface tells no tale, is the most difficult subject with which the mining engineer has to deal, and yet in many cases the difficulty is entirely ignored, with the result that the cost of exploration is enormously increased.

The chapter on the ironstones of the carboniferous rocks contains little that is new, the bulk of the information being contained in the "Memoirs of the Geological Survey." The analyses given relate to the iron ores collected by S. H. Blackwell, and the author might with advantage have mentioned the fact. The formation of this collection marked an epoch in the history of metallurgy, for, notwithstanding the magnitude of the interests involved in the iron and steel industries, no systematic collection representing the workable ores of the kingdom had been made until the Great Exhibition of 1851. The want was then supplied by the liberal exertions of Mr. S. H. Blackwell, a Dudley ironmaster, who, after the exhibition, presented this extensive and interesting series to the Museum of Practical Geology, munificently placing a sum of £500 at the disposal of Dr. Percy towards defraying the cost of their analysis. The results were subsequently published at Government expense in the "Memoirs of the Geological Survey."

The perplexing and fascinating subject of the genesis of iron ore deposits is treated by the author with great fulness, and his conclusions deserve attentive consideration. He brings forward a large amount of evidence in support of the views propounded by Sorby and by Huddleston that the ores of Cleveland and Northamptonshire were produced by the replacement of an ordinary limestone, and extends the theory to all deposits occurring in the secondary rocks. The source of the iron, he believes, may have been in the clays, with which all these deposits are closely connected. In the case of the red hæmatites, he is of opinion that the most likely